MATH CALCULATIONS IN MASTERINGASTRONOMY

Generally, every weekly homework assignment will have one or two problems, each of which involves a calculation or a series of calculations. Since there are 20 questions per assignment and each question is weighted the same, problems involving calculations may represent as much as 10% of the maximum points possible for a given assignment. Obviously, one could skip the math-based problems and still pass the course. However, every semester we have a significant number of students who finish the course just short of a higher grade by a few points. The difference could be those skipped math problems! So if you would like to increase your chances for receiving a higher grade or simply like solving problems that involve math, here are some tips for finding those correct answers.

You Can Do Math – When it comes to problems involving math, many students will state "I am no good at math" or something of a similar tone. For this astronomy course, we very rarely find this statement to be true. The reason is simple. The math in this course involves no more than basic skills in arithmetic and elementary algebra – skills that the vast majority of people use in their everyday lives without realizing it. So the first thing you need to do (if you have not done so already) is to stop saying, "I can't do math".

Formulas – The real issue with doing assignment questions involving calculations (where student frustration is at its highest) is with determining which formula to use (if it is not given in the actual question). There is no magic cure for deciding which formula to use for a given situation. It basically takes listening to your instructor during lecture, reading your text, and comprehending the situation at hand. However, we can still offer you a few hints: 1) Look through the chapter that corresponds to your homework and see if the "Cosmic Calculation" parallels your assignment question; 2) A significant number of calculations involve a "rate equation" (e.g., distance = speed x time, where speed is the rate in this case); 3) Look for common themes to previous assignments (e.g., the inverse square law implicitly, if not explicitly, appears throughout the text); and 4) Take a look at Appendix B – "Useful Formulas".

Data – Once you have a formula, usually you will have one unknown (which is what you will be solving for) and you will need to plug in numbers for the other variables. Often the problem itself will tell you what these numbers are. However, you will not necessarily be given everything up front; you will be expected to look for "standard" data in a table or similar arrangement. DO NOT use the Internet or similar sources to obtain these numbers. Use either the appendices in the back of your book (or any other location within your text) or the "Constants" table found on the *MasteringAstronomy* web site.

Powers of 10 and Units – Once you have your formula and your numbers, you cannot simply plug in and calculate. You need to be sure that you have everything in compatible units and if not, you will need to convert accordingly. Also, you can save yourself a lot of grief if (under certain circumstances) you work with numbers expressed in powers of ten (or scientific notation). You are expected to know how to do all this. However, if your skills in these topics are a bit rusty, consult Appendix C, "A Few Mathematical Skills", for an excellent review.

Significant Digits – More often than not, your calculations will not end in "nice" numbers (e.g., an integer like 2). When this occurs, it is only natural to ask how many digits should be reported. From a scientific point of view, the number of digits to report is determined by the precision of the data being used and the mathematical operations being employed (e.g., see http://members.aol.com/profchm/sig_fig.html or http://en.wikipedia.org/wiki/Significant_Digits). However, you will not need to know all these details for reporting your calculations. Instead, use one of the following two "rules" depending on whether or not *MasteringAstronomy* states a desired significant digit precision:

1. No Statement of Desired Significant Digits: Use 5 significant digits in all calculations and report your answers to five significant digits.

2. Stated Significant Digits: Use 5 significant digits in all calculations and report your answers in the number of significant digits requested.

Making Sense and Getting Help – Once you obtain an answer, always ask yourself if the answer makes sense. For example, one way to do this is to go back to your formula and replace the values of the variables with values that are expressed in scientific notation with only one significant digit. You should then be able to do the calculation on a piece of paper and get an order-of-magnitude answer to compare to the value you obtained from a calculator. If they are not in the same ballpark, this is a sign that you need to check your math (both on the calculator and on the paper). Another way to test an answer is by using common sense. If you are asked to determine the mass of a fictitious planet orbiting our Sun and you end up deriving a mass 10 times more massive than the Sun, then you probably made an error somewhere.

Finally, the Sierra College Tutoring Centers, located in the LRC of both the Rocklin and Grass Valley campuses (also http://www.sierracollege.edu/StudentServices/tutorTesting/index.html), are a valuable resource for obtaining help with math and science homework. Also, your instructor is very willing to help outside of class – all you need to do is ask.